Processing Geometrical Information in the PSA

I. Barbarisi, C. Vallat, C. Rios, R. Docasal & PSA Team

Isa.Barbarisi@esa.int
1. Geometry in PDS3: Where are we?
2. Geometry in PDS4
3. Geometry and irregular bodies
   a. Workflow, GIS? No, thanks.
   b. B3F Files
   c. Geometry Computator
Geometry in PDS3

PDS format: The tragedy of the geometry

The PDS Standard Reference comprises about 500 pages, but . . .

1. There is nothing about how geometry is provided!
2. In practice, geometry is stored in a wide variety of formats and locations.
PDS3 Geometrical Data Parsing

Geometry Index File → Geom Parser → WKT Multiline String → PostGIS DB

Multilinestring:

```
MULTILINestring ((10 10, 20 20, 10 40),
(40 40, 30 30, 40 20, 30 10))
```

Geometry:

```
geometry ST_CoVexHull(geometry geomA);
geometry ST_Simplify(geometry geomA, float tolerance);
```
HRSC Altitude Info

H1768_0009_SR3
Coordinate System is:
PROJECTSINUSOIDAL MARS,
GEOCSGCICCS MARS,
DATUMID MARS,
SPHEROIDMARS.3396000.0],
PRIMEM[Reference Meridian],
UNIT[Degree],
TARGET["Sinusoidal"],
PARAMETER[[false_easting],0],
PARAMETER[[false_northing],0],
UNIT["metre",1],
AUTHORITY["EPSG","9001"],
Origin = (36140.0000000000000000, 4907540.0000000000000000)
Pixel Size = (40.0000000000000000000, 40.0000000000000000000)
Metadata:
AREA_OR_POINT/Area
BANDWIDTH/250.0 <nm>
CENTER_FILTER_WAVELENGTH/600.0 <nm>
DATA_SET_ID/"MEK+HRSC-S-REFR-MAPPRESSED-V2.0"
INSTRUMENT_ID/HRSC
INSTRUMENT_NAME/"HIGH RESOLUTION STEREO CAMERA"
MISSION_NAME/"MARS EXPRESS"
PRODUCT_CREATION_TIME/2006-07-29T06:40:21.000Z
PRODUCT_ID/"H1768_0009_SR3.IMG"
TARGET_NAME/MARS
Image Structure Metadata:
INTERLEAVE=BAND
Corner Coordinates:
Upper Left (36140.000, -4907540.000) (100s50150.07"W, 82d4754.61"S)
Lower Left (-36140.000,-4974420.000) (101d4545.28"W, 83d5534.21"S)
Upper Right (31060.000, -4907580.000) (91d4911.22"W, 82d4754.61"S)
Lower Right (31060.000, -4974420.000) (91d25077.77"W, 83d5534.21"S)
Center (-3540.000, -4941000.000) (96d2214.66"W, 83d2144.36"S)
Band 1 Blocks=16040 Type=Byte, ColorInterp=Gray
Min=0.000 Max=9052.000, Computed Min/Max=0.000, 255.000
Minimum=0.000, Maximum=9052.000, Mean=7195.920, StdDev=734.083
NoData Value=0
Metadata:
STATISTICS_MAXIMUM=9052
STATISTICS_MEAN=7195.92
STATISTICS_MINIMUM=0
STATISTICS_STDDEV=734.083

Demo (Prototype!!)
http://npsadev.esac.esa.int/3D/mars/3D_ImageGallery/H0334.html
Web 3D Visualization PSA Products

**HiRISE:** HIGH RESOLUTION IMAGING SCIENCE EXPERIMENT

**HRSC:** High/Super Resolution Stereo Color Imager

**Demo**

http://npsadev.esac.esa.int/3D/mars/3D_ImageGallery/hirise200.html

**Demo**

http://npsadev.esac.esa.int/3D/mars/3D_ImageGallery/HRSC1000.html

**Demo**

http://npsadev.esac.esa.int/3D/mars/3D_ImageGallery/bessengen.html

**Workflow**

**GDAL - Geospatial Data Abstraction Library**

1) Convert PDS .IMG to .TIF
2) Get Info from TIF and get minimum/maximum height
3) Convert TIF to PNG with elevation information in grey val
4) Convert TIF to BIN
5) Increase level of details: gdal-hillshade
6) Add Color

**WEBGL/three.js**

1) Import TerrainLoader
2) Load Mesh
3) Load Texture from previously created PNG
4) Add trackball Controls

**PSA Gallery**

1) Open PSA GIS Map
2) Explore Footprints near interested region
3) Click on 3D View
4) Explore/Enjoy Footprints
Virtual Reality: Immersive Experience on Mars

Demo, prototype!!:
http://npsadev.esac.esa.int/3D/mars/3D_ImageGallery/cardboardHRSC.html

**WEBGL/three.js**
1) Import StereoEffect  
2) Convert/Load Footprint  
3) Load Texture  
4) Add trackball Controls

**iPhone/iPad/Others**
1) Open **PSA GIS MAP**  
2) Select Region of Interest  
3) Click on Footprint to get Details  
4) Click on Virtual Reality Button  
5) Put iPhone inside Google CardBoard (1$ !!)  
6) Explore/Enjoy Footprints/Surfaces

ExoMars16  
Shape Models  
MAPS  
ExoMarsRSP

European Space Agency
<geom:Footprint_Vertices>
  <geom:Pixel_Intercept>
    <geom:pixel_latitude unit="deg">-9.880536</geom:pixel_latitude>
    <geom:pixel_longitude unit="deg">210.438683</geom:pixel_longitude>
  </geom:Pixel_Intercept>
  <geom:Pixel_Intercept>
    <geom:pixel_latitude unit="deg">-7.805367</geom:pixel_latitude>
    <geom:pixel_longitude unit="deg">210.479152</geom:pixel_longitude>
  </geom:Pixel_Intercept>
  <geom:Pixel_Intercept>
    <geom:pixel_latitude unit="deg">-7.809591</geom:pixel_latitude>
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  </geom:Pixel_Intercept>
  <geom:Pixel_Intercept>
    <geom:pixel_latitude unit="deg">-9.887552</geom:pixel_latitude>
    <geom:pixel_longitude unit="deg">210.728336</geom:pixel_longitude>
  </geom:Pixel_Intercept>
</geom:Footprint_Vertices>
1. In an effort of homogenize all different formats, locations, standard
Geometry and Irregular Bodies

Info: The model matches NAVCAM data gathered up to mid-late July 2015.

Download
OBJ File (63MB)
OBJ File (3.6MB)
WRL File (20MB)
STL File (256MB)
Use Cases:

1. An observation could be searched by criteria such as start-time, instrument, and illumination conditions. The User Interface (UI) of the PSA will return a list of observations that match the criteria and will enable projection on the surface of the object for visualization.

2. A user will be able to select a region on the surface of the target and make a query of all observations covering the selected region (additional filters, such as the one mentioned above, could also be included to refine the search). The UI will return a list of observations that could be projected on the surface of the object.
Significant distortions. White dashed lines the boundary of the two lobes: the map is centred on the small lobe; the big lobe covers the left–right–bottom edges of the map; and the contact area between the two lobes covers mainly the top of the map (regions Hapi, Neith, Sobek).
Problem of fake matches

- if it is visible (not obscured by other terrain)
- if it is illuminated (not shadowed by other terrain)
B3F Files for NAVCAM (Bjorn Grieger)

SC position
Sun position
Boresight
FOV bounds

All in body fixed frame
1. B3F file for the NAVCAM. There is one row for each NAVCAM image. Each row contains the UTC time and seven 3-vectors. The vectors are:

   a. spacecraft position  
   b. Sun position (light time corrected)  
   c. Instrument boresight direction  
   d. Field of view corner directions

2. All values in the body fixed frame, derived from SPICE.
1. Searching the $\approx 17000$ NAVCAM images for a POI and checking
   a. if it is in the FOV,
   b. if it obeys prescribed illumination constraints,
   c. if it is visible (not obscured by other terrain),
   d. if it is illuminated (not shadowed by other terrain)
   e. all on the fly, nothing precomputed, takes two seconds (in the worst case).

2. The PSA team is working on implementing searching along these lines (starting with the NAVCAM B3F).